

IN THE CLAIMS:

Please cancel claims 1 - 10, 22- 40, 49, and 52, without prejudice.

Claims 1 - 10 (cancelled).

11. (original) A stereo echo canceller associated to a space provided therein with two loudspeakers and two microphones for forming four audio transfer systems through which stereo sounds are reproduced by said respective loudspeakers and are collected by said respective microphones,

the canceller comprising: first and second filter sections that are provided corresponding to the first and second microphones for subjecting an audio signal supplied to the first loudspeaker to convolution calculations so as to produce first and second echo cancel signals, respectively;

third and fourth filter sections that are provided corresponding to the first and second microphones for subjecting another audio signal supplied to the second loudspeaker to convolution calculations so as to produce third and fourth echo cancel signals, respectively;

a first subtracting section that performs echo cancellation by subtracting said first and third echo cancel signals from a collected audio signal of the first microphone; and

a second subtracting section that performs echo cancellation by subtracting said second and fourth echo cancel signals from another collected audio signal of the second microphone, wherein

said stereo echo canceller further comprises a transfer function calculating section that respectively derives filter characteristics corresponding to transfer functions of said four audio transfer systems based on a cross-spectrum calculation between a

sum signal and difference signal of stereo audio signals to be reproduced by said respective loudspeakers and the collected audio signals of said respective microphones, thereby to set said derived filter characteristics to corresponding ones of said first to fourth filter sections, respectively.

12. (original) A stereo echo canceller as recited in claim 11, further comprising:  
an input section that inputs said stereo audio signals;  
a sum/difference signal producing section that produces said sum signal and said difference signal of the stereo audio signals inputted from said input section; and  
a main signal transmission system that transmits the stereo audio signals inputted from said input section to said respective loudspeakers without passing through said sum/difference signal producing section,

wherein said transfer function calculating section derives the filter characteristics corresponding to the transfer functions of said four audio transfer systems based on the cross-spectrum calculation between the sum signal and difference signal produced by said sum/difference signal producing section and the collected audio signals of said respective microphones, and sets the derived filter characteristics to corresponding ones of said first to fourth filter sections, respectively.

13. (original) A stereo echo canceller associated to a space provided therein with two loudspeakers and two microphones for forming four audio transfer systems through which stereo sounds are reproduced by said respective loudspeakers and are collected by said respective microphones,

the canceller comprising: first and second filter sections that are provided corresponding to the first and second microphones for subjecting an audio signal

supplied to the first loudspeaker to convolution calculations so as to produce first and second echo cancel signals, respectively;

third and fourth filter sections that are provided corresponding to the first and second microphones for subjecting another audio signal supplied to the second loudspeaker to convolution calculations so as to produce third and fourth echo cancel signals, respectively;

a first subtracting section performs echo cancellation by subtracting said first and third echo cancel signals from a collected audio signal of the first microphone; and

a second subtracting section that performs echo cancellation by subtracting said second and fourth echo cancel signals from another collected audio signal of the second microphone, wherein

said stereo echo canceller further comprises a transfer function calculating section respectively derives estimated errors of transfer functions of said four audio transfer systems based on a cross-spectrum calculation between respective one of a sum signal and a difference signal of stereo audio signals to be reproduced by said respective loudspeakers and respective one of echo cancel error signals obtained by subtracting the corresponding echo cancel signals from the collected audio signals of said two microphones, thereby to update filter characteristics of said first to fourth filter sections to values that cancel said estimated errors, respectively.

14. (original) A stereo echo canceller as recited in claim 13, further comprising:

an input section that inputs said stereo audio signals;

a sum/difference signal producing section that produces said sum signal and said difference signal of the stereo audio signals inputted from said input section; and

a main signal transmission system that transmits the stereo audio signals inputted from said input section to said respective loudspeakers without passing through said sum/difference signal producing section,

wherein said transfer function calculating section derives the estimated errors of the transfer functions of said four audio transfer systems based on the cross-spectrum calculation between the sum signal and difference signal produced by said sum/difference signal producing section and the respective echo cancel error signals, and updates the filter characteristics of said first to fourth filter sections to the values that cancel said estimated errors, respectively.

15. (original) A stereo echo canceller as recited in claim 13, further comprising a correlation detecting section that detects a correlation between the sum signal and the difference signal of said stereo audio signals, and that stops the updating of said filter characteristics when a value of said correlation is no less than a predetermined value.

16. (original) A stereo echo canceller associated to a space provided therein with two loudspeakers and two microphones for forming four audio transfer systems, the canceller comprising:

an input section that inputs audio signals of stereo sounds from an outside, which are reproduced by said respective loudspeakers and collected by said respective microphones through the audio transfer systems;

first and second filter sections that is provided corresponding to the first and second microphones for subjecting an audio signal supplied to the first loudspeaker to convolution calculations so as to produce first and second echo cancel signals,

respectively;

third and fourth filter sections that are provided corresponding to the first and second microphones for subjecting another audio signal supplied to the second loudspeaker to convolution calculations so as to produce third and fourth echo cancel signals, respectively;

a first subtracting section that performs echo cancellation by subtracting said first and third echo cancel signals from a collected audio signal of the first microphone; and

a second subtracting section that performs echo cancellation by subtracting said second and fourth echo cancel signals from another collected audio signal of the second microphone, wherein

said stereo echo canceller further comprises a transfer function calculating section respectively derives filter characteristics corresponding to transfer functions of said four audio transfer systems based on a cross-spectrum calculation between said collected audio signals of said respective microphones and mutually orthogonal two uncorrelated composite signals produced by applying a principal component analysis to stereo audio signals to be reproduced by said respective loudspeakers, thereby to set said derived filter characteristics to corresponding ones of said first to fourth filter sections, respectively.

17. (original) A stereo echo canceller as recited in claim 16, further comprising:

an orthogonalizing section that applies said principal component analysis to the stereo audio signals inputted from said input section to produce said mutually orthogonal two uncorrelated composite signals; and

a main signal transmission system that transmits the stereo audio signals

inputted from said input section to said respective loudspeakers without passing through said orthogonalizing section,

wherein said transfer function calculating section derives the filter characteristics corresponding to the transfer functions of said four audio transfer systems based on the cross-spectrum calculation between the two uncorrelated composite signals produced by said orthogonalizing section and the collected audio signals of said respective microphone, and sets the derived filter characteristics to corresponding ones of said first to fourth filter sections, respectively.

18. (original) A stereo echo canceller associated to a space provided therein with two loudspeakers and two microphones for forming four audio transfer systems, the canceller comprising:

an input section that inputs stereo audio signals from an outside, which are reproduced by said respective loudspeakers and collected by said respective microphones through the audio transfer systems;

first and second filter sections that are provided corresponding to the first and second microphones for subjecting an audio signal supplied to the first loudspeaker to convolution calculations so as to produce first and second echo cancel signals, respectively;

third and fourth filter sections that are provided corresponding to the first and second microphones for subjecting another audio signal supplied to the second loudspeaker to convolution calculations so as to produce third and fourth echo cancel signals, respectively;

a first subtracting section performs echo cancellation by subtracting said first and

third echo cancel signals from a collected audio signal of the first microphone; and

a second subtracting section performs echo cancellation by subtracting said second and fourth echo cancel signals from another collected audio signal of the second microphone, wherein

said stereo echo canceller further comprises a transfer function calculating section that respectively derives estimated errors of transfer functions of said four audio transfer systems based on a cross-spectrum calculation between mutually orthogonal two uncorrelated composite signals produced by applying a principal component analysis to stereo audio signals to be reproduced by said respective loudspeakers and respective echo cancel error signals obtained by subtracting the corresponding echo cancel signals from the collected audio signals of said two microphones, thereby to update filter characteristics of said first to fourth filter sections to values that cancel said estimated errors, respectively.

19. (original) A stereo echo canceller as recited in claim 18, further comprising:  
an orthogonalizing section applies a principal component analysis to the stereo audio signals inputted from said input section to produce said mutually orthogonal two uncorrelated composite signals; and

a main signal transmission system that transmits the stereo audio signals inputted from said input section to said respective loudspeakers without passing through said orthogonalizing section,

wherein said transfer function calculating section derives the estimated errors of the transfer functions of said four audio transfer systems based on the cross-spectrum calculation between the two uncorrelated composite signals produced by said

orthogonalizing section and the respective echo cancel error signals, and updates the filter characteristics of said first to fourth filter sections to the values that cancel said estimated errors, respectively.

20. (original) A stereo echo canceller as recited in claim 18, further comprising a double talk detecting section that is provided for detecting double talk in which a sound other than that reproduced by said loudspeakers is inputted into said microphones,

wherein said transfer function calculating section makes relatively longer an update period of said filter characteristics when said double talk is detected, while makes relatively shorter the update period of said filter characteristics when said double talk is not detected.

21. (original) A stereo sound transfer apparatus associated to two spaces each forming said four audio transfer systems, wherein the stereo echo canceller recited in claim 11 is arranged in each space, so that the stereo audio signals, which have been echo-canceled by said stereo echo cancellers, are transmitted between said two spaces.

Claims 22 - 40 (cancelled)

41. (original) An echo cancel method associated to a space provided therein with a plurality of loudspeakers and one or a plurality of microphones for forming a plurality of audio transfer systems through which audio signals of multi-channels having a correlation with each other are reproduced by said respective loudspeakers and are collected by said microphones, and designed for performing an echo cancellation by subtracting an echo cancel signal from the audio signals collected by the respective microphone or from composite signals obtained by combining the collected audio



signals, the method comprising:

inputting a plurality of low-correlation audio signals which are obtained by suitably combining first audio signals of multi-channels and which have a lower correlation with each other than that among said first audio signals of multi-channels;

generating second audio signals of multi-channels having a correlation with each other by computation based on the inputted low-correlation audio signals;

feeding the generated second audio signals to the respective loudspeakers so as to reproduce audio sounds;

feeding the generated second audio signals or the inputted low-correlation audio signals to filters;

estimating individual transfer functions of said plurality of said audio transfer systems or a plurality of composite transfer functions obtained by suitably combining said individual transfer functions based on the inputted low-correlation audio signals so as to set corresponding filter characteristics;

producing echo cancel signals by applying said set filter characteristics to the second audio signals or the low-correlation audio signals fed to the filters; and

subtracting said echo cancel signals from collected audio signals obtained by collecting the reproduced audio sounds by the microphones or from composite audio signals obtained by suitably combining said collected audio signals, thereby performing the echo cancellation.

42. (original) An echo cancel method as recited in claim 41, wherein the inputted low-correlation audio signals are obtained by adding or subtracting the first audio signals of multi-channels with each other.

43. (original) An echo cancel method associated to a space provided therein with a plurality of loudspeakers and one or a plurality of microphones for forming a plurality of audio transfer systems through which audio signals of multi-channels having a correlation with each other are reproduced by said respective loudspeakers and are collected by said microphones, and designed for performing an echo cancellation by subtracting an echo cancel signal from the audio signals collected by the respective microphone or from composite signals obtained by combining the collected audio signals, the method comprising:

inputting a plurality of first low-correlation audio signals which are obtained by suitably combining first audio signals of multi-channels and which have a lower correlation with each other than that among said first audio signals of multi-channels;

generating second audio signals of multi-channels having a correlation with each other by computation based on the inputted first low-correlation audio signals;

feeding the generated second audio signals to the respective loudspeakers so as to reproduce audio sounds;

generating second low-correlation audio signals of multi-channels based on the generated second audio signals;

feeding the generated second audio signals or the generated second low-correlation audio signals to filters;

estimating individual transfer functions of said plurality of said audio transfer systems or a plurality of composite transfer functions obtained by suitably combining said individual transfer functions based on the generated second low-correlation audio signals so as to set corresponding filter characteristics;

producing echo cancel signals by applying said set filter characteristics to the second audio signals or the second low-correlation audio signals fed to the filters; and

subtracting said echo cancel signals from collected audio signals obtained by collecting the reproduced audio sounds at the microphones or from composite audio signals obtained by suitably combining said collected audio signals, thereby performing the echo cancellation.

44. (original) An echo cancel method as recited in claim 43, wherein the inputted first low-correlation audio signals are obtained by adding or subtracting the first audio signals of multi-channels with each other.

45. (original) An echo canceller associated to a space provided therein with a plurality of loudspeakers and one or a plurality of microphones for forming a plurality of audio transfer systems through which audio signals of multi-channels having a correlation with each other are reproduced by said respective loudspeakers and are collected by said microphones, and designed for performing an echo cancellation by subtracting an echo cancel signal from the audio signals collected by the respective microphone or from composite signals obtained by combining the collected audio signals, the echo canceller comprising:

an inputting section that inputs a plurality of low-correlation audio signals which are obtained by suitably combining first audio signals of multi-channels and which have a lower correlation with each other than that among said first audio signals of multi-channels;

a demodulating section that is provided for generating second audio signals of multi-channels having a correlation with each other by demodulating the inputted low-

correlation audio signals, and for feeding the generated second audio signals to the respective loudspeakers so as to reproduce audio sounds;

an estimating section that estimates individual transfer functions of said plurality of said audio transfer systems or a plurality of composite transfer functions obtained by suitably combining said individual transfer functions based on the inputted low-correlation audio signals so as to set corresponding filter characteristics;

a filter section that produces echo cancel signals by applying said set filter characteristics to the second audio signals or the low-correlation audio signals fed to the filter section; and

a subtracting section that subtracts said echo cancel signals from collected audio signals obtained by collecting the reproduced audio sounds at the microphones or from composite audio signals obtained by suitably combining said collected audio signals, thereby performing the echo cancellation.

46. (original) An echo canceller as recited in claim 45, wherein the inputted low-correlation audio signals are obtained by adding or subtracting the first audio signals of multi-channels with each other.

47. (original) An echo canceller associated to a space provided therein with a plurality of loudspeakers and one or a plurality of microphones for forming a plurality of audio transfer systems through which audio signals of multi-channels having a correlation with each other are reproduced by said respective loudspeakers and are collected by said microphones, and designed for performing an echo cancellation by subtracting an echo cancel signal from the audio signals collected by the respective microphone or from composite signals obtained by combining the collected audio

signals, the echo canceller comprising:

an inputting section that inputs a plurality of first low-correlation audio signals which are obtained by suitably combining first audio signals of multi-channels and which have a lower correlation with each other than that among said first audio signals of multi-channels;

a demodulating section that is provided for generating second audio signals of multi-channels having a correlation with each other by demodulating the inputted first low-correlation audio signals, and for feeding the generated second audio signals to the respective loudspeakers so as to reproduce audio sounds;

an estimating section that is provided for generating second low-correlation audio signals of multi-channels based on the generated second audio signals, and for estimating individual transfer functions of said plurality of said audio transfer systems or a plurality of composite transfer functions obtained by suitably combining said individual transfer functions based on the generated second low-correlation audio signals so as to set corresponding filter characteristics;

a filter section that produces echo cancel signals by applying said set filter characteristics to the second audio signals or the second low-correlation audio signals fed to the filter section; and

a subtracting section that subtracts said echo cancel signals from collected audio signals obtained by collecting the reproduced audio sounds at the microphones or from composite audio signals obtained by suitably combining said collected audio signals, thereby performing the echo cancellation.

48. (original) An echo canceller as recited in claim 47, wherein the inputted first

low-correlation audio signals are obtained by adding or subtracting the first audio signals of multi-channels with each other.

Claims 49 - 52 (cancelled).